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July 15, 1996

William F. Caton
Acting Secretary
Office of the Secretary
Federal Communications Commission
Washington, DC 20554

Re: Comments of ITS America in ET Docket No. 96-102

Dear Secretary Caton:

Please substitute the enclosed original letter from ITS America for the faxed version previously filed in this matter.

Thank you for your consideration.

Sincerely,

Katherine S. Poole
Kelly & Povich, P.C.
Counsel for ITS America

INTELLIGENT TRANSPORTATION SOCIETY OF AMERICA

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July 15, 1996

William F. Caton
Acting Secretary
Office of the Secretary
Federal Communications Commission
Washington, DC 20554

Re: Notice of Proposed Rule Making for Unlicensed NII/SUPERNet Operations in the 5 GHz Frequency Range, ET Docket No. 96-102

Dear Secretary Caton:

The Intelligent Transportation Society of America ("ITS America"),[1] a nonprofit organization dedicated to the development and deployment of intelligent transportation systems across the United States, has reviewed the Federal Communication Commission's ("the Commission's") proposal to make 350 MHz of spectrum available at 5.15 - 5.35 GHz and 5.725 - 5.875 GHz for NII/SUPERNet devices. ITS America recognizes the exciting potential of NII/SUPERNet and supports making spectrum available for its use. We are concerned, however, that the upper 25 MHz (5850 - 5875) proposed for NII/SUPERNet use overlaps the band identified by ITS America and the Federal Highway Administration ("FHWA") as ideal spectrum for the location of developing intelligent transportation system ("ITS") technologies.[2] We submit these comments to help the Commission determine whether the proposed NII/SUPERNet use of the 5.850 - 5.875 GHz band and planned ITS use of the band will be compatible.[3]

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[1] ITS America's members are drawn from all facets of business, academia, and government which have a stake in the application of technology to transportation. The views expressed herein are those of ITS America and do not necessarily represent the views of the individual members of the Society.

[2] See Notice of Proposed Rule Making in the Matter of Amendment of the Commission's Rules to Provide for Unlicensed NII/SUPERNet Operations in the 5 GHz Frequency Range, ET Docket No. 96-102, at 11 (May 6, 1996) ("NPRM").

[3] The Commission has stated in its proposed rule that "at this time the spectrum requirements for Intelligent Transportation Systems (ITS) and their possible impact on other services is not clear. Accordingly, [ITS spectrum compatibility with NII/SUPERNet] is beyond the scope of this proceeding." NPRM at 14. ITS America has received direction from its Board of Directors to pursue, when appropriate, the allocation of spectrum for

The term "Intelligent Transportation Systems" or "ITS" describes a variety of tools and technologies in the fields of information processing, communications, control, and electronics employed to improve the safety and efficiency of the nation's transportation infrastructure. Dedicated Short Range Communication ("DSRC") systems form the primary subset of ITS applications being considered for the 5.8 GHz band. DSRC provides critical roadway information to drivers and vehicle information to roadway systems while vehicles are operating at high speeds. Among other benefits, DSRC promises to save thousands of lives by warning drivers of impending hazards, to reduce traffic congestion by allowing high-speed, electronic toll collection, and to make hands-free, feet-free driving a reality through a fully automated highway system.

A recently completed study commissioned by FHWA indicates that NII/SUPERNet devices operating in the 5.850 - 5.875 GHz range may adversely affect DSRC operation when the devices function within 60 meters of each other.[4] This conclusion is based on the assumption that NII/SUPERNet devices are operating at 0.1 watt or less. If the Commission permits higher-powered NII/SUPERNet links -- up to 1 watt -- as contemplated in its proposed rule, interference with DSRC operations increases dramatically.

FHWA's study also indicates that interference with DSRC operations decreases when NII/SUPERNet devices are operated indoors or in non-mobile applications, both of which generally fall outside of DSRC communications zones.[5] Thus, interference problems between DSRC and NII/SUPERNet may be minimized by restricting mobile NII/SUPERNet equipment to frequencies below 5.850 MHz, requiring licensing of outdoor NII/SUPERNet links in the 5.850 - 5.875 range, and by limiting NII/SUPERNet transmit power to 0.1 watts.

At this time, however, FHWA's study is preliminary and has not been confirmed with follow-up tests. Additional studies are in progress on these issues and ITS America is hopeful that all parties involved can work together to achieve a sharing protocol in the 5.850 - 5.875 GHz band that will permit both NII/SUPERNet and DSRC uses.

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emerging ITS "Dedicated Short Range Communication" ("DSRC") technologies. The prime candidate for a DSRC allocation appears to be the 5.850 - 5.925 GHz band. Significant efforts are underway examining use of this band, as well as other potential candidate bands, by ITS America, FHWA, and by industry. In addition, the attached, recently completed study commissioned by FHWA sheds new light on ITS - NII/SUPERNet compatibility, providing information that was not available during adoption of the NPRM. In light of these developments, we believe the Commission should revisit the proper scope of this proceeding and consider NII/SUPERNet spectrum compatibility with planned ITS applications in the current rulemaking.

[4] See "DSRC Coexistence With NII/SUPERNet" at 6 (appended as Attachment 1).

[5] Id. at 6.

The above precautions, while advisable, do not guarantee that DSRC operations will operate free from NII/SUPERNet interference in the 5.850-5.875 GHz range. What FHWA's study does conclusively suggest is that additional tests of DSRC and NII/SUPERNet compatibility should be performed before the Commission makes the 5.850 - 5.875 GHz band available for NII/SUPERNet use.

Deferring use of the 5.8 GHz band should not delay or even affect the implementation of NII/SUPERNet. The Commission has proposed to make this spectrum available in response to petitions for rulemaking from the Wireless Information Networks Forum ("WINForum") and Apple Computer, Inc. ("Apple"). In its petition, WINForum asserts that "250 MHz of spectrum will be needed in the near term" to support deployment of NII/SUPERNet.[6] Apple states that 300 MHz is the maximum bandwidth needed for current implementation.[7] The NPRM in Docket 96-102 has responded by proposing to dedicate 350 MHz of spectrum to NII/SUPERNet -- 50 megahertz more than either petitioner requested for current use.

Presumably, the Commission has proposed making this amount of spectrum available in response to WINForum's request for 100 - 150 MHz for future applications when "deployment of SUPERNet begins on a larger scale."[8] WINForum acknowledges, however, that additional spectrum will not be needed until "a later date when practical experience has been gained."[9] Until "a later date" arrives, there is simply no reason for the Commission to make the 5.850 - 5.875 GHz band available for NII/SUPERNet use. In the event that the Commission does make the 5.850 - 5.875 band available in the current rulemaking, it should be allocated as a reserve band not available for current NII/SUPERNet use pending conclusion of ITS - NII/SUPERNet compatability studies.

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[6] See WINForum Petition at iv.

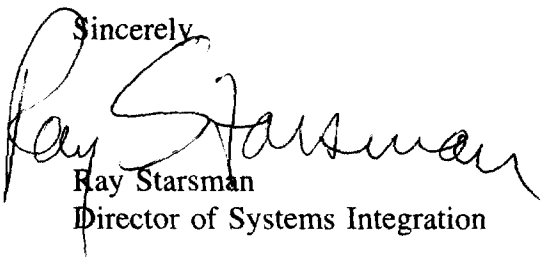
[7] See Apple Petition at 1.

[8] See WINForum petition at 14.

[9] Id. at n.4 (emphasis added).

ITS America appreciates the opportunity to submit these comments.

Sincerely,



Ray Starsman
Director of Systems Integration

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Attachment

ATTACHMENT 1

Attachment

DSRC Coexistence with NII/SUPERNet

1.0 Background

Currently the Federal Communications Commission (FCC) is receiving comments on a Notice of Proposed Rulemaking regarding Unlicensed National Information Infrastructure (NII)/ Shared Unlicensed Personal Radio Network (SUPERNet) Operations in the 5 GHz Frequency Range. Apple Computer, Inc. and Wireless Information Network Forum (WINForum) would like to amend Part 15 rules so that these devices can be used to support wireless Local Area Networks (LANs) at 5.15-5.35 and 5.725-5.875 GHz.

Since the top 25 MHz of this proposed allocation overlaps the 5.850-5.925 GHz frequency band which will be sought for Dedicated Short Range Communication (DSRC) operations, there is a concern that NII/SUPERNet devices may adversely affect DSRC implementation. This paper looks at the interference issue and concludes that there are compatibility issues if both types of devices are operating within 60 meters of each other.

2.0 Assumptions

It is assumed that relatively short range, commercial, DSRC applications will be operating in the 5.850-5.875 portion of the band. Examples include electronic parking payment, and drive-through applications. Electronic parking payment enables the vehicle driver to pay for parking without cash. Upon entry or exit from a parking lot a driver would have the parking charge billed or debited by passing billing and payment data across the DSRC system. Fast food establishments, dry-cleaners, car-washes, automobile repair services, and other companies which operate drive-thru operations could use DSRC technology to transfer price and payment data between the payment collection system in the building and the vehicle system.

This analysis uses information provided by Bosch on one of its systems which is capable of performing the actions mentioned above. If NII/SUPERNet devices are allowed to operate as proposed, *longer range* DSRC applications seem better suited for the 5.875-5.925 portion of the band where NII/SUPERNet interference would not be an issue.

The proposed NII/SUPERNet devices would be relatively low-powered, less than .1 watts. This analysis looks at the signal received by a DSRC beacon receiver from an NII/SUPERNet device which uses an "omni-directional" antenna. It is certainly plausible that a higher gain antenna might be utilized though it is not dealt with in this analysis. It should be noted that the DSRC antenna *is* directional. During calculation, the following parameters are used:

DSRC Equipment

beacon antenna height:	H_antenna := 2.5 m
antenna boresight elevation (see Fig. 1):	Boresight := 45 deg
antenna gain (on boresight):	G_boresight := 13.5 dB

NII/SUPERNet Emitter

emitter height:	H_emitter := 1.3 m
emitter transmit power:	P_t := .1 watt
emitter antenna gain:	G_t := 0 dB

General

transmit frequency:	f := 5.85 GHz

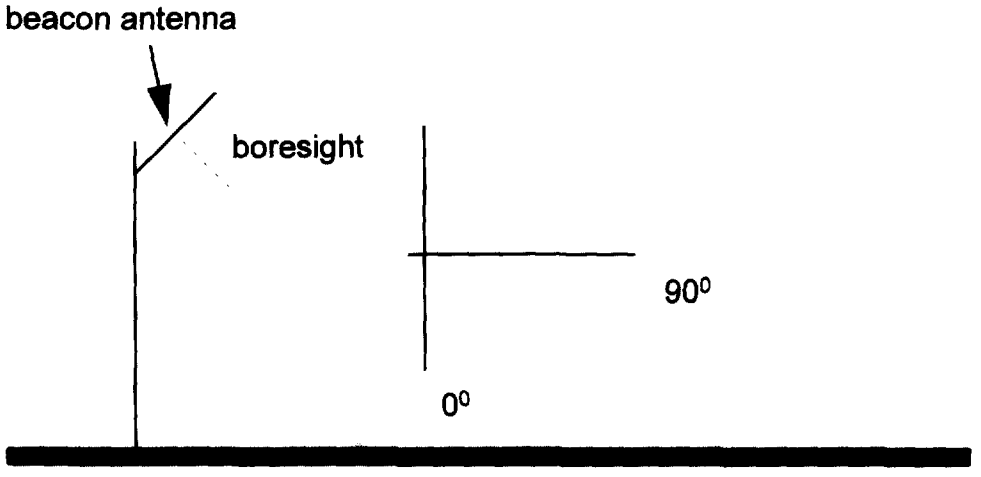

Figure 1: Beacon Antenna Configuration

The beacon antenna is directional; therefore the gain changes with both azimuth and elevation. This analysis looks at emitters that are within the 3 dB beamwidth in azimuth and can be at various distances from the receiver (i.e. variable elevation). The cases looked at are: on boresight in elevation, just outside of the main communications area, and distances where the angle above boresight approaches the horizon.

3.0 Maximum Signal Acceptable Interference Level

In order to calculate the interference potential of NII/SUPERNet devices, it is necessary to determine the maximum signal interference level that the beacon receiver can accept. The maximum acceptable interference level (P_r_int), assuming a desired signal-to-interference ratio of 20 dB, is

P_r_int := P_r_tag - 20 P_r_tag := the maximum received signal level from the DSRC tag.

Given that the maximum tag Effective Isotropic Radiated Power (EIRP) is -24 dBm[1], P_r_tag can be computed using the equation for free space propagation:

$$P\_r := \frac{P\_t \cdot G\_t \cdot G\_r \cdot \lambda^2}{(4 \cdot \pi \cdot range)^2} \text{ watts}$$

This equation can be written in decibel notation as follows

$$P\_r = P\_t + G\_t + G\_r + 20 \cdot \log(\lambda) - 20 \cdot \log(4 \cdot \pi \cdot range) \text{ dBm} \quad \text{(i)}$$

where P_r_tag = P_r; P_t = -24 dBm, G_t is set to 0 dB (because P_t is given as EIRP); G_r = 13.5; and range is equal to the distance between the tag and the beacon receiver. Assuming that the tag is on boresight, the distance between the tag and the receiver antenna can be computed as follows:

$$range := \frac{H\_antenna - H\_emitter}{\cos(45)} \text{ m} = 1.697 \text{ m}$$

Therefore

P_r = -62.9 dBm and P_r_int = -82.9 dBm

4.0 Cases

4.1 Case 1, On Boresight in Elevation

For this case, the NII/SUPERNet device may be anywhere within the 3 dB beamwidth in azimuth, and the elevation angle above boresight equals 0^0. Since the distance between the

[1] The maximum tag EIRP is based upon the Draft Pre-standard, Road Traffic and Transport Telematics(RTTT) Dedicated Short-range Communication (DSRC), CEN TC278 WG9 SG.L1, August 1995

emitter and the reader antenna will not change with azimuth, the range is 1.697 m as previously derived for the boresight case.

The antenna gain as seen by the receiver will change with changes in emitter location. This can be represented mathematically as

$$G\_r := G\_boresight - gain\_drop\_elevation - gain\ drop\_azimuth \ \ dB \quad (ii)$$

Since the emitter is seen as "on boresight" in elevation

$$gain\_drop\_elevation = 0 \ \ dB$$

Since in azimuth it is assumed that the emitter is within the 3 dB beamwidth

$$gain\_drop\_azimuth = 3 \ \ dB$$

Therefore G_r = 13.5 - 0 - 3 = 10.5 dB

With an NII/SUPERNet transmit power of .1 watts, equation (i) shows that the minimum interference level seen at the beacon receiver is

$$P\_r = 20\ dBm + 0 + 10.5 + 20 \cdot \log(.051) - 20 \cdot \log(4 \cdot \pi \cdot 1.697) = -21.9\ dBm$$

Obviously this is well above the maximum allowable interference level of -82.9 dBm.

4.2 Case 2, Outside of the Main Communication Area

Case 2 examines the signal strength seen from an NII/SUPERNet emitter that is located just outside of the main communication area. The Bosch access control system utilizes a communications zone which is approximately 3-4 meters long[2]. For this interference calculation, it is assumed that the emitter is 10 meters from the reader. Range can be calculated as:

$$range := \sqrt{(H\_antenna - H\_emitter)^2 + horiz\_distance} = 10.07\ m$$

At this location, it is expected that the receiver will see at least a 15 dB drop due to elevation. Using equation (ii)

$$G\_r = 13.5 - 3 - 15 = -4.5\ dB$$

[2] Access Control System Based on the Emerging European Standard for 5.8 GHz Short Range Communications, Buchs, Detlefsen, Grabow, 1996

Therefore

$$P\_r = 20\ \text{dBm} + 0 + -4.5 + 20\cdot\log(.051) - 20\cdot\log(4\cdot\pi\cdot 10.07) = -52.4\ \text{dBm}$$

Again this is well above the maximum allowable interference level of -82.9 dBm.

4.3 Case 3, Angle Above Boresight Approaches the Horizon

As an emitter is placed farther and farther away from the DSRC reader antenna, the look angle between the two approaches the horizon. That is to say that the reader antenna "sees" the emitter almost 45^0 above boresight (see Figure 1) in elevation. In order to minimize the effect of emitters outside of the communications zone, the reader antenna is built in such a way that there is a null when approaching 45^0 above boresight. Based upon information from Bosch, this analysis assumes that the antenna will have at least 30 dB drop when the elevation angle approaches the horizon.

Therefore, equation (ii) yields an antenna gain, as seen by the receiver, of

$$G\_r = 13.5 - 3 - 30 = -19.5\ \text{dB}$$

By re-writing equation (i) the minimum distance from the beacon receiver can be calculated as follows.

$$\text{range} := \frac{1}{4\cdot\pi}\cdot 10^{\frac{(P\_t + G\_t + G\_ - P\_r) + 20\cdot\log(\lambda)}{20}} \qquad \text{(iii)}$$

Setting

$$P\_r = P\_r\_int = -87.9\ \text{dB}$$

equation (iii) yields: range = 60.3 m

So given the assumptions listed above, an NII/SUPERNet device needs to be at least 60.3 meters away from the beacon antenna in order to maintain a Signal-to-Noise Ratio (SNR) of 20 dB.

5.0 Conclusions

This analysis has looked at the possibility of interference caused by an NII/SUPERNet device and concludes that the placement of such a device within 60 meters of a DSRC reader can cause problems. If the device is moved outside of the 3 dB azimuth beamwidth, the necessary separation distance will decrease substantially. However, this configuration is not addressed within this study because Apple and WINForum have proposed that NII/SUPERNet operations be unlicensed. As such the location of such equipment will be difficult to predict and its position outside of the 3 dB beamwidth cannot be assured.

It should be noted that Apple and WINForum anticipate that NII/SUPERNet devices would mostly be used indoors. For this situation, Case 1 does not apply because a device that operates indoors will not be within the DSRC communications zone. Case 2 may be unlikely as well. Certainly the attenuating effects of most buildings would decrease the signal level seen in Case 2, and the separation distance calculated in Case 3.

Also, the FCC has requested comment on whether or not higher powered NII/SUPERNet links should be allowed (up to 1 watt). Based upon the above discussion for devices operating at 1/10th of that power, it does not appear that higher powered links can comfortably co-exist with DSRC operations.